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THE ABERTHAW INDEX OF BUILDING COSTS

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THE INDEX

INDICES of the cost of constructing a standard reinforced concrete factory building, supplied by the Aberthaw Construction Company of Boston to the REVIEW, are shown in the accompanying table. The basic figure is the actual cost of construction of a seven-story reinforced concrete factory building erected by the Aberthaw Company in 1914. Estimates have been made of the cost of putting up the same building if construction were begun on January 1, 1920, July 1, 1920, and on the first of the month from January to October 1921. The index number for any given date is secured by expressing the estimated cost of construction, beginning on that date, as a percentage of the actual cost in 1914. Although the indices are based on the estimated costs of constructing a selected type of building they show the fluctuation in costs of reinforced concrete construction in general.

The building chosen as a base was actually constructed between August 22 and December 31, 1914; building costs were so uniform during the year that it is accurate to consider the base to be the entire year. This building was chosen for two reasons. The building itself is typical of the reinforced concrete structures erected by the company, as is also the proportion of costs involved for the various classes of labor and various kinds of materials. In the second place, its construction was an almost "ideally handled job"; that is, a job which involved no waste and no unusual costs. Consequently, actual and estimated costs correspond closely, both for the job as a whole, and for its component parts.

RELATIVE COST OF CONSTRUCTING A STANDARD REINFORCED CONCRETE FACTORY BUILDING

Date	Index No.	Date	Index No.
The year 1914	100	1921 Apr. 1	186
		May 1	175
1920 Jan. 1	190	June 1	172
July 1	265	July 1	167
1921 Jan. 1	241	Aug. 1	161
Feb. 1	220	Sept. 1	160
Mar. 1	197	Oct. 1	157

DETERMINATION OF COSTS IN 1914

The general method of cost determination for concrete buildings is described in *Estimating Concrete Buildings*, by Clayton W. Mayers, Chief Estimator of the Aberthaw Construction Company (published by that company in 1920). The first step is drawing up a complete list of all materials and labor needed. The quantities required are then determined by making a careful survey of the plans of the proposed building. Unit costs are obtained and the total cost of each item entering into the construction of the building is determined by multiplying the number of units comprising the item by the unit cost. Allowance for unforeseen contingencies may be made separately; in making the estimates upon which its index numbers since 1914 are based, the Aberthaw Company has included such allowance as an element in unit costs. Costs of this kind are not included in the costs of construction of the standard building in 1914.

The table (p. 343) presents itemized costs for the building constructed in 1914, together with estimates for the same items if the building were constructed beginning May 1, 1921. Labor costs, which have not been segregated in the table, amounted to $30,258 in 1914, 33 per cent of total costs. In May 1921, labor costs were estimated to form 35 to 40 per cent of the total, or from $57,000 to $65,000.

The largest item for the building, "columns and floors," will be used to illustrate the method followed in arriving at the cost per item in 1914. Thus, 3,810 cubic yards of concrete, "1–3–6 mix," were required for columns and floors. The unit cost per cubic yard of concrete was made up as follows:

Labor				.96
Material:				
Cement, $1\frac{2}{3}$ bbls.	at	1.25	2.08	
Sand, $\frac{1}{2}$ cu. yd.	at	.70	.35	
Crushed stone, $1\frac{3}{10}$ tons	at	.97	1.26	3.69
Plant				1.08
				5.73

The method used here differs from that described in Mr. Mayer's book (pp. 43–45) in handling overhead, that is, such items as "job superintendent," "time keeper," "tool boy," etc. In the illustration developed in Mr. Mayer's text, overhead was included in the total as a separate item; in the present case it was included in unit costs. It was found that for the job as a whole the ratio of the overhead costs to the total of labor, material, and plant costs was 3.1 per cent. The overhead was then apportioned among the various elements of the cost by adding 3.1 per cent to each item. For example, in the figures we have just considered, the item of 96 cents for labor included an allowance of 3.1 per cent for overhead. The costs of $1.25 per bbl. for cement, 70 cents per cubic yard for sand, and 97 cents per ton for crushed stone, all included this allowance for overhead. The plant item of $1.08 also included this allowance of 3.1 per cent. If overhead were excluded, the total unit cost for labor, material, and plant would be only $5.56. The allowance for overhead increased this figure by 17 cents, making it $5.73.

Where the items did not lend themselves to division into homogeneous units, unit costs were not calculated, Actual Cost of Reinforced Concrete Building Constructed in 1914, with Estimated Cost on May 1, 1921 *

	Quantity	Actual Costs, December, 1914		Estimated Costs, May 1, 1921	
		Per unit	Total	Per unit	Total
Concrete:					
Footings	1,002 cy.	$5.52	$5,531	$12.10	$12,124
Columns and floors	3,810 cy.	5.73	21,831	11.45	43,625
Paving	204 cy.	6.05	1,234	11.85	2,417
Curtain walls, wall beams and penthouse	273 cy.	7.18	1,960	12.80	3,494
Window sills, including forms	2,392 fl.	.388	928	.62	1,483
Stairs and landings, including forms	1,620 fl.	.628	1,017	.72	1,166
Crickets on roof	34 cy.	6.98	237	8.52	290
Coping	527 fl.	.243	128	.31	163
Granolithic finish (laid integral), unit price per 100 sq. ft.	10,333 sf.	3.05	315	5.82	601
Granolithic finish (laid after), unit price per 100 sq. ft.	64,510 sf.	6.35	4,096	10.85	6,999
Carborundum rub, unit price per 100 sq. ft.	33,494 sf.	3.85	1,290	6.00	2,010
Forms:					
Footings	3,972 sf.	.174	691	.20	794
Columns (interior)	12,028 sf.	.102	1,227	.16	1,924
Column heads	98 (no.)	4.85	475	7.00	686
Drop panels	98 (no.)	7.07	693	9.00	882
Column (exterior)	31,634 sf.	.121	3,828	.138	4,365
Column brackets	154 (no.)	3.38	521	3.75	578
Floors	65,800 sf.	.0742	4,882	.093	6,119
Wall beams and parapet	21,859 sf.	.0975	2,131	.143	3,126
Floor beams and slab between	17,644 sf.	.107	1,888	.169	2,982
Coping	520 fl.	.175	91	.217	113
Penthouse walls	4,188 sf.	.112	469	.256	1,072
Scuttles	2 (no.)	30.00	60	32.50	65
Reinforcement:					
Footings	$46\frac{2}{10}$ tons	32.30	1,492	56.70	2,620
Columns	$126\frac{6}{10}$ tons	33.00	4,178	59.20	7,495
Floor steel	$178\frac{5}{10}$ tons	31.50	5,623	54.60	9,746
Beams and sundries	$69\frac{9}{10}$ tons	36.40	2,544	64.00	4,473
Excavation	2,918 cy.	1.20	3,501	1.55	4,523
Sheeting	......	....	237	....	432
Masonry:					
6″ and 8″ tile	15,921 sf.	.196	3,121	.325	5,174
Plastering	†	†	525	†	1,152
Steel Sash and Glass and Glazing	20,430 sf.	$.29\frac{1}{4}$	5,976	.56	11,440
Doors:					
Wood	......	....	309	....	575
Fire	......	....	740	....	1,300
Miscellaneous Iron:					
Roof scuttle	2 (no.)	15.50	31	33.00	66
Ladder to roof	1 (no.)	....	79	....	175
Cannel iron door frames	81 (no.)	14.10	1,142	25.70	2,082
Door sills	18 (no.)	15.06	271	31.80	572
Inserts, pipe sleeves	9458 (no.)	.16	1,513	25.60	2,421
Z-bars	4920 (no.)	$.10\frac{1}{2}$	517	$.23\frac{1}{2}$	1,156
Setting grates	......	....	16	....	38
Ventilator covering	......	....	18	....	25
Stair railings	......	....	101	....	210
Sundry iron and steel	......	....	191	....	200
Roofing and flashing	†	†	998	†	1,900
Board walls on roof	......	....	29	....	58
Painting	......	....	823	....	1,630
Engineering plans	......	....	950	....	2,000
Liability insurance	......	....	2,220	....	4,000
Net cost	......	....	$92,668	....	$162,541

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* Allowances for Superintendence and Job Overhead expenses have been included in the individual unit prices. Contractor's Profit has not been included in above estimate. † Sub-contracts.

and total costs only were obtained. Sundry iron and steel, engineering plans, and liability insurance were such items. Two items, plastering and roofing and flashing, were handled by granting the work to contractors at a lump sum. The total costs were obtained by adding together the costs for all items, whether calculated per unit or, as in the cases just mentioned, simply stated as lump sums.

Manufacturers' profits were not included in the cost statement.

DETERMINATION OF COSTS, 1920–21

On January 1 and July 1, 1920, and on the first of each month during 1921, estimates were made of the cost of reproducing the factory building constructed in 1914. The items and quantities required remained as before; new costs were established for the items, to accord with the necessary change in expenditure. The recent figures are thus estimates, in contrast to the figure of 1914, which is that for actual cost.

The material prices employed in making these estimates were not market quotations, but the prices at which, to the best of the estimator's judgment, the Aberthaw Company would actually have been able to purchase the materials. Costs for labor took into account labor efficiency, which varies widely with the activity in building trades. During periods of activity, the cost sheets which come to the estimator's desk will show him labor costs exceeding the standard by percentages which may lie within certain limits. On the basis of these cost returns, the estimator in considering future work would add certain percentages to the various labor costs in order to allow for the low efficiency of labor. These percentages would differ for various classes of labor. In periods of depression the situation would be reversed. It would be possible to keep on the payrolls only those men whose efficiency was considerably above the standard. Consequently, the costs returns reaching the estimator would show actual labor costs running under the standard, and, in order to allow for this fact, he would deduct various percentages from the labor items in making current estimates.

The considerations involved may be brought out by the following comment of the Aberthaw Company on the estimates for recent months:

Materials: The market is spotty. Published quotations of prices have not been closely followed since it is assumed that careful purchasing for cash will bring concessions from presumably established price levels.

Labor: In terms of actual accomplishment labor is showing a higher degree of efficiency than has been shown in the cost tables of twenty years of carefully maintained tabulations. This, in part, is due to drastic selection of the best among workmen of known qualifications. At the same time the labor spirit is excellent, and the high morale of labor gangs results in considerable healthy rivalry in accomplishment. Labor turnover is negligible. Fares to and from the job are not being paid.

Transportation: While freight rates remain high, deliveries are prompt. Much purchasing may be done from stock as cheaply as from the mill, with the result of quick delivery by truck to the site.

General: Comparatively few operations are being started before plans are fully drawn and specifications detailed. This obviates the high cost of delay and alterations. The rate of construction, further, may be set sufficiently slow to enable maximum in progress scheduling.